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# THE AGRICULTURAL SITUATION FOR 1918

A SERIES OF STATEMENTS PREPARED UNDER THE  
DIRECTION OF THE SECRETARY OF AGRICULTURE

## PART III SUGAR

MORE BEET AND CANE SUGAR SHOULD BE  
PRODUCED



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## OUR DEPENDENCE UPON IMPORTED SUGAR.

THE SUPPLY OF SWEETS—sugar, sirup, molasses, and honey—should be increased to meet the demand in this country and abroad. For sugar, the principal sweet, the United States in normal times depends upon Cuba to furnish half of its supply. We depend upon our insular possessions, Hawaii, Porto Rico, and the Philippines, for one-fourth of our supply. The balance, one-fourth, is produced in Continental United States. But the Allies have been drawing heavily from the Cuban crop in recent months, and this has proportionately decreased the amount of sugar available for the United States. Thus with fairly fixed sources of supply and with limitations on increase in production, every extra spoonful of sugar made or saved means an extra spoonful for the Allies, for our soldiers, or for ourselves. It is of paramount importance, therefore, that we maintain

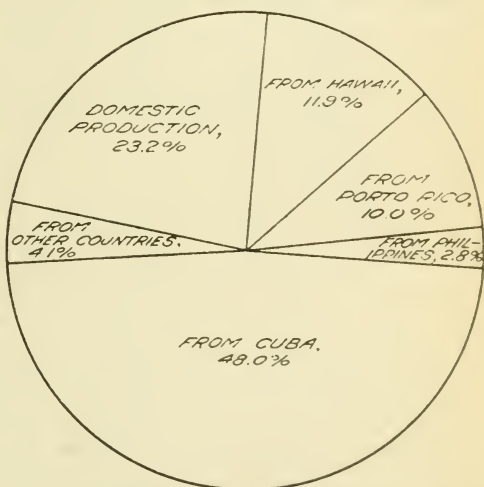


FIG. 1.—The diagram shows the sources of sugar supply of the United States in 1917. In the Continental United States production amounted to 1,131,500 tons or 23.2 per cent of the total supply. Imports to the Continental United States from Cuba were 2,334,500 tons or 48 per cent; from Hawaii 586,500 tons or 11.9 per cent; from Porto Rico 488,500 tons or 10 per cent; from the Philippines 134,000 tons or 2.8 per cent; from other countries 198,000 tons or 4.1 per cent.

TABLE 1.—*Sugar: Production, imports, and exports for the United States. 1909-1917.*

Year of harvest.	Production.	Received from Hawaii, Porto Rico, and Philippine Islands. <sup>1</sup>	Imports, year beginning July 1, from—			Exports, year beginning July 1.		Production plus imports minus exports.	
			Cuba.	Other countries.	All countries.	Domestic. <sup>2</sup>	Foreign.	Total.	Per capita, household and manufactured.
Annual average.	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.	Pounds.
1909-13....	920,500	1,004,500	1,928,000	150,600	2,073,000	54,500	9,500	3,939,000	85.1
1914 .....	968,500	1,098,500	2,392,500	154,500	2,597,000	300,500	16,500	4,296,500	87.1
1915 .....	1,013,000	1,102,000	2,575,500	132,500	2,708,000	842,500	18,000	3,962,500	79.0
1916 .....	1,131,500	1,204,000	2,331,500	193,000	2,532,500	624,500	3,000	4,240,500	83.2
1917 .....	1,083,800	.....	.....	.....	.....	.....	.....	.....	.....

<sup>1</sup> Not considered imports in this tabulation. <sup>2</sup> Refined from imported as well as domestic sugar.

and wherever possible increase the sugar crop of the United States, also every other possible supply of sweets. (See Table 1 and Figure 1.)

#### WHY ENGLAND, FRANCE, AND ITALY ARE SHORT OF SUGAR.

It is common knowledge that the supply of sugar in some parts of the United States has been short. It is not so well understood, however, that there has been an annual shortage of more than 2,000,000 tons in the world since the war began and that the shortage is likely to continue, primarily because of the destruction of a large number of sugar mills and the devastation of a considerable area of sugar-producing lands in Europe.

Prior to the war practically all of the belligerent countries, with the exception of the United Kingdom and Italy, exported sugar, the total amount being upward of 3,000,000 tons. War, however, has changed the sugar production map and at the same time has shifted the channels of trade. In 1918 it is estimated that the Allies must import a minimum of 1,200,000 tons of sugar. The United Kingdom and France depended to a considerable extent upon Germany, Austria-Hungary, Belgium, and Russia for sugar. These sources were shut off by the war. The United Kingdom alone thus lost the source of more than half of her normal supply of sugar and has turned to new as well as other old sources for her supply. The changes thus brought about have been largely a diversion of the product of Mauritius to the United Kingdom instead of to India, and an expansion of the imports of unrefined sugar from Cuba, the Philippines, and Peru. For refined sugar she drew upon the United States and Java. However, the Allies cannot turn to such exporting countries as Java and Mauritius without being forced to go a much longer distance and over a



more perilous route than across the Atlantic. If the Allies are compelled to go to these countries it will require an extra amount of shipping which is needed for transportation of American soldiers and supplies to France and England.

Russia's exports practically ceased in 1914, and she is now reported as somewhat short of sugar. Italy's crop decreased last year and her imports have increased largely since the war began. Italy's normal consumption, however, is small and her deficit is not serious. A more detailed statement of the world situation is given in the following pages.

In normal times before the war the most important beet-sugar producing countries were Germany, Austria-Hungary, Russia, France, and the United States. (See Table 2.)

TABLE 2.—*Production of beet sugar in principal countries.*

Country.	Beet sugar (year of harvest).	
	1913. <sup>1</sup>	1917. <sup>2</sup>
	<i>Short tons.</i>	<i>Short tons.</i>
United States.....	733,401	980,000
Germany.....	2,993,704	1,344,000
Russia.....	1,681,247	1,008,000
Austria-Hungary.....	1,854,169	896,000
France.....	790,790	235,200
Belgium.....	251,023	140,000
Netherlands.....	231,073	235,200
Sweden.....	150,760	112,000
Denmark.....	158,865	128,800
Spain.....	186,680	123,200
Italy.....	336,823	84,000
World.....	9,433,783	5,304,880

<sup>1</sup> Official figures. <sup>2</sup> Willett and Gray.

Germany has long recognized the value of sugar beets and as the leading beet sugar producer of the world devoted 1,317,000 acres to the crop in 1913 which yielded about 18,673,000 tons of beets, producing approximately 3,000,000 tons of sugar. In that same year she exported about 1,231,000 tons of sugar, which was about normal, since her exports annually amounted to nearly half of her production. The bulk of these exports found their way into the sugar barrels of England and France. The declaration of war, of course, shut off this supply, and both England and France had to look elsewhere to replace the German product.

Somewhat the same situation obtained in Austria-Hungary as in Germany. The Dual Monarchy stood second among the nations grow-

ing sugar beets, being outclassed only by Germany. On 1,082,000 acres, in 1913, she produced 13,049,000 tons of beets, which made about 1,854,000 tons of sugar. This country also annually produced large quantities of sugar for export. During the decade 1903-12 the United Kingdom received from Austria-Hungary 49 per cent of the sugar which she exported, amounting to 28 per cent of her production during the period. France also drew upon Austria-Hungary for sugar.

In Russia in 1913 about 1,756,000 acres were planted to beets, yielding about 13,602,000 tons, from which were manufactured 1,681,000 tons of sugar. In normal times Russia has produced a large surplus of sugar for export, the amount for the decade ending with 1913 being 17.6 per cent of her total production. In 1911 and again in 1912 exports amounted to about 500,000 tons. In these years the United Kingdom took nearly one-half of Russia's sugar exports, amounting to 229,000 tons in 1911 and 161,000 tons in 1912. Since the war began, however, the United Kingdom has only imported a few thousand tons of refined sugar from Russia, or only a very small fraction of her normal imports from that country. Thus another source of England's sugar supply was closed as a result of the war. Germany is now in possession of the Polish beet fields, constituting about one-third of the Russian sugar-beet territory.

Prior to the war France ranked fourth among the countries of Europe in the growing of sugar beets. War affected the sugar production sharply and at once. The sugar section is in the extreme northern part, composed chiefly of five Departments—Nord, Aisne, Oise, Somme, and Pas-de-Calais. They contain 180 of the 232 sugar factories, leaving only 52 for all other Departments. These areas, of course, contain also the sugar-beet producing acreage, and portions of each of these Departments, as well as some others, are located within the territory held by Germany. This, with her decreased farm and other labor supply, accounts to a considerable extent for the greatly curtailed acreage and production of sugar in France since the war began. Of the 232 factories in operation in 1913, just prior to the war, only 65 were in use in 1916 and the production of sugar, amounting to 752,000 tons for the period 1911-13, decreased to 235,000 tons in 1917.

Exports of beet sugar from France before the war were decreasing and imports increasing. For the calendar years 1911-13 the annual exports were 185,000 tons compared with 104,000 tons in 1916, while the average annual imports increased from 218,000 tons for the years 1911-13 to 580,000 tons in 1916. The production in 1917 of only 235,200 tons compared with the pre-war average of about 750,000 tons, leaves France short about 500,000 tons compared with normal. That amount will have to be made up by imports or the French people will have to reduce their consumption of sugar to the difference between the im-



ports and the 500,000 tons. France has been compelled to reduce her moderate per capita consumption from an average of 30.6 pounds in the household and in the industries for the decade prior to the war to a household consumption of 13.2 pounds for 1917, or about one-fourth pound per week. Further, the French have placed restrictions upon the use of sugar in the bakeries, candy shops, and condensed milk, chocolate, and other industries.

Sugar beets were grown in all nine of the provinces of Belgium before the war. For a decade, prior to Germany's attack upon Belgium, the acreage averaged annually about 138,113 acres, which produced on the average about 1,770,000 tons of beets. In 1913 the outturn of sugar was estimated to be 251,000 tons. By 1917 the ravages of war had reduced it to 140,000 tons or to about one-half of the pre-war output. But since the exports of sugar from Belgium for a decade prior to the war amounted to about two-thirds of her production or about 166,000 tons annually, Belgium must still be producing enough sugar to feed the Belgian population, provided it were available to them. The war, of course, put a stop to Belgium's exports, thus shutting off another portion of the imports of England and France and at the same time giving Germany another source of sugar, since she has been operating a number of the Belgium sugar factories.

TABLE 3.—*Production of cane sugar in principal countries.*  
[Willett and Gray.]

Country.	Cane sugar (year of harvest).	
	1913.	1917.
	<i>Short tons.</i>	<i>Short tons.</i>
United States.....		
Hawaii.....	336,000	254,240
Porto Rico.....	685,440	588,000
Central America.....	407,680	532,000
Mexico.....	34,720	28,000
West Indies:	160,160	39,200
British.....		
French.....	142,240	212,800
Cuba.....	196,000	89,600
Argentina.....	3,258,080	3,584,000
Brazil.....	340,480	168,000
Peru.....	255,360	420,000
Spain.....	281,120	296,800
British India (consumed locally).....	12,320	6,720
Formosa.....	2,873,920	3,080,000
Japan.....	238,560	504,000
Java.....	77,280	
Philippine Islands.....	1,683,194	2,016,000
Egypt.....	263,200	303,800
Mauritius.....	84,000	112,000
Natal.....	308,000	250,880
Australia.....	108,640	128,800
Fiji.....	332,640	296,800
Other countries.....	123,200	112,000
	420,390	454,160
Total.....	12,622,624	13,477,800

Prior to the war Italy grew enough sugar beets to be practically self-sustaining as far as her sugar needs were concerned. Production has steadily declined, however, from an average of about 221,000 tons for the period 1910-14 to about 101,000 tons in 1917. As will be seen by the production figures, Italy's sugar consumption normally is low. To meet her decreasing production, however, she has increased her imports from about 8,000 tons in 1911-13 inclusive to about 83,000 tons in 1916. The Central Powers now occupy a part of Venetia where about one-half of the sugar beets usually are grown and where many of the sugar factories are located.

The United Kingdom produces practically no sugar, but depends upon imports. She is the world's second largest sugar market, being surpassed only by the United States. Prior to the war she consumed about 2,000,000 tons annually. As already outlined, she obtained about one-half of her supply from Germany and one-fifth from Austria-Hungary. From France, Belgium, and Russia she obtained about one-tenth of her supply, about one-tenth from the Netherlands, about one-tenth from Java, and smaller amounts from other countries. Up to the beginning of 1917 the United Kingdom was able to secure her normal supplies of sugar, but her imports of beet sugar ceased in 1914 and since that year she has been forced to import increasing quantities of cane sugar, both raw and refined. Taking into account the large production of India, which is almost wholly for native consumption, the British Empire produces normally more sugar than any other country, but the colonial surplus was large enough to furnish the mother country only 10 per cent of her total imports, hence the United Kingdom depended largely upon European sources which supplied her with nearly all of the beet sugar that she imported. For her supply of cane sugar, however, she drew largely upon Java, Cuba, Peru, British West Indies, and Mauritius. (See Table 3.) Since the war the United Kingdom has been forced to draw more heavily upon these as well as other sources. The imports from United States increased from 431 tons in 1913 to 99,000 tons in 1916. Her total imports of raw sugar from all countries in 1916 were 1,258,000 tons, of which 611,000 tons came from Cuba, or two and one-half times as much as in 1913. In 1917 the United Kingdom's demands upon the island were even greater.

Java, like Cuba, exports practically all of the sugar she produces, and since her exports normally amount to about 1,500,000 tons annually, she is an important factor in the world's sugar market. In fact, Java and Cuba contribute about one-half of the world's exports of sugar. Normally Java's principal customers are China, British India, and Japan. However, since the beginning of the war the United Kingdom and the Continent of Europe have been importing from one-fourth to one-half of Java's exports, and it is estimated that her

present supply of sugar is large. Thus Java is an important contributor to the world's sugar crop, but, as stated earlier, if either England or France is compelled to import large quantities of sugar from Java it will be over a much longer and more perilous route than from the United States or Cuba.

#### POSSIBILITIES OF INCREASING THE AMOUNT OF SUGAR AVAILABLE FOR THE ALLIES IN 1918.

At no time in the world's history has the supply of sugar greatly exceeded the annual requirements for this important staple. In fact, the world has been producing sugar with one hand and feeding it to itself with the other with great haste. The substantial increase in the world's production which occurred up to the outbreak of the war never materially exceeded the demand, and since the war began the annual deficiency has been more than 2,000,000 tons.

The extent of the world's output of sugar in 1918, as in every year, depends largely upon weather, seed, labor, and milling conditions. Among the foreign countries England, Australia, Japan, France, and Spain offer some possibilities in increased production of beet sugar. No great dependence, however, can be placed upon a much larger supply being developed immediately in these foreign countries, because of the scarcity of labor in some and necessity for mill construction in others, and because time is required to accomplish this development work.

It has already been pointed out in the foregoing discussion that the normally large exports of sugar to the Allies from Germany, Austria-Hungary, Russia, and Belgium have been cut off. The present sources for large amounts of sugar, with the exception of Java, are practically limited to Cuba, the United States and its Insular Possessions. The need for increasing sugar production in 1918 in Cuba and the Continental United States, Hawaii, Porto Rico, and the Philippines, therefore, is without question.

Cuba holds first place among the cane-sugar-producing countries of the world and also is the most important exporting country. Cuba's exports prior to the war averaged about 95 per cent of her production, and 90 per cent came to the United States. This constituted about one-half of the sugar we consume. In 1913 Cuba's production totalled 3,258,000 tons and in 1917 about 3,584,000 tons.

It has been said that Cuba would be capable of producing all the sugar the United States normally consumes if her acreage were expanded greatly, weather conditions favorable, and labor and mills available. Undoubtedly this is true, but under present conditions the

extent of the increase, if any, cannot be foretold. However, Cuba has increased her production materially since the beginning of the war, but at the same time the demands upon her have been enlarged far beyond her ability to meet them.

Of our Insular Possessions, Hawaii annually ships to this country about 500,000 tons of raw cane sugar, Porto Rico about 350,000 tons, and the Philippines about 150,000 tons. The total imports from these sources constitute about one-fourth of the sugar we consume. In Hawaii it is not possible to expand the acreage materially, due to the large percentage of the area of the islands which is now devoted to the crop, the result of the rapid expansion of the industry in recent years. The sugar output of Porto Rico also has expanded greatly in late years and further extension of the cane-growing area is limited because of lack of suitable land for growing the crop. Even now the sugar crop in Porto Rico is being curtailed by a serious cane disease. Both in Hawaii and Porto Rico, however, it is possible to increase production through the application of better cultural methods in growing and caring for the cane. In the Philippines, however, it is possible to expand considerably the area devoted to cane culture; also the method of sugar extraction and preparation are still crude on many plantations and capable of marked improvement. It is authentically stated that in some mills the sugar losses amount nearly to one-half of the sugar in the cane.

In the Continental United States, where we produce one-fourth of the amount of sugar which we consume, it is feasible to maintain and possibly to add to our acreage of sugar cane in the South and the beet acreage in 19 northern States. A very large increase in the yield of beets and cane also could be secured on each acre by following better cultural methods which will be outlined in succeeding pages.

### WAYS OF INCREASING SUGAR PRODUCTION.

Curtailing the consumption of sugar in this country undoubtedly should release more sugar for shipment to the Allies who are in very much greater need for it than we are. But we have another duty to perform which cannot be done by the people at large. It falls primarily upon the growers of sugar-cane and sugar beets. Upon them depends, to a considerable degree, whether they will increase their usual contribution of one-twentieth to one-sixteenth to the world's sugar bowl.



In order to consider where and how this increase may come about, a short review and description of the more vital factors in the sugar-producing industry of this country will help to a consideration of the present possibilities. We will now discuss the various ways of increasing the production of sugar-cane and later take up sugar beets.

#### ORIGIN AND DEVELOPMENT OF THE CANE-SUGAR INDUSTRY IN THE UNITED STATES.

The oldest source of our domestic sugar is a section of Louisiana, beginning a few miles east of the Mississippi River and extending roughly for 100 miles westward, and reaching from an east and west line passing not far above Baton Rouge, southward to the Gulf Coast. Outside of this region cane is grown generally throughout the Gulf States, but there it is used almost exclusively to make sirup and not sugar. Practically the only other cane sugar from our Southern States, outside of this Louisiana region, is made in a few scattered localities in Texas, where the industry has been expanding in recent years. Cane is said to have been introduced in Louisiana about 1751, and an attempt was made to make sugar eight years later but without success. It was not until 1795 that the first successful sugar mill was erected in Louisiana. The industry was originally part of farming, and the mechanical equipment was rather simple, consisting of a set of rollers for crushing the cane and some kettles for boiling the juice.

As early as 1845 about 45 per cent of the sugar planters in Louisiana were without sugar mills and their cane was sent to neighboring plantations for grinding. Steam power was being introduced rapidly at this time and the making of the sugar increased also. With the increase in the amount of machinery needed for a mill and its consequent cost and larger efficiency, the number of mills decreased and a still larger number of planters sent their cane to neighbors' mills for sugar making. One of the most important improvements in the mill was the vacuum pan, the purpose of which is to boil and concentrate the cane juice in a vacuum or under low pressure. In 1849, out of 1,536 sugar houses, only 11 were reported as having vacuum pans, while in 1916, out of 150 operating sugar factories, 141 were vacuum-pan houses. The open pans now are used largely for making cane sirup. Numerous other improvements were introduced. Better methods for crushing the cane and extracting the juice were used, improved systems for boiling the juice, and labor-saving devices for handling materials about the factory; and these improvements have been followed by larger and still larger outputs per factory.



## SUGAR CANE AREA AND PRODUCTION.

In 1849 the factories averaged each about 75 to 85 tons of sugar for the season; in 1916 the average exceeded 2,000 tons. The factories had increased in size and efficiency, not only producing more sugar, but getting more in proportion to the amount of cane used. Within the Louisiana sugar belt, cane is by far the most important commercial crop. In the 23 sugar parishes the cane area in 1909 amounted to 16.4 per cent of the total area of the improved land in farms. The leading sugar parishes showed an area in cane equal to 35 per cent of the total improved land, and corn 33.1 per cent of the total. The large number of mules required in the cane fields makes corn an important product for farm consumption rather than for sale. In the parishes of St. Mary, Lafourche, and Terrebonne cane occupied 41.6 per cent of the total area in improved land and corn 30 per cent, while hay and forage occupied 16.1 per cent. Hence, practically 87 per cent of all improved farm lands in those parishes may be regarded as devoted directly or indirectly to the sugar-cane industry. The sugar-producing area may be greatly expanded, however, in other parts of the State. Of the total amount of sugar made in Louisiana in 1916, amounting to 303,000 tons, 119,000 tons or 39.2 per cent was produced in the three parishes just mentioned. These parishes contained also 51 of the State's 150 factories which were in operation in 1916.

The crop averages annually from 11 to 17 tons of cane per acre, and the amount of sugar from 135 to 152 pounds per ton of cane. The harvested area increased from 183,000 acres in 1915 to 221,000 in 1916,

TABLE 4.—*Summary of Louisiana sugar production, 1911-1917.*

[1 short ton=2,000 pounds.]

Year of cane harvest.	Factories in operation.	Sugar made.		Cane used for sugar.		Estimated area of cane used for sugar.	Molasses made. <sup>1</sup>
		Total.	Average sugar per ton of cane.	Total.	Average per acre.		
	Number.	Short tons.	Pounds.	Short tons.	Short tons.	Acres.	Gallons.
1911.....	188	352,874	120	5,887,000	19	310,000	35,062,525
1912.....	126	153,573	142	2,162,000	11	197,000	14,302,169
1913.....	153	292,698	139	4,214,000	17	248,000	24,046,320
1914.....	149	242,700	152	3,199,000	15	213,000	17,177,443
1915.....	136	137,500	135	2,018,000	11	183,000	12,743,000
1916.....	150	303,900	149	4,072,000	18	221,000	26,154,000
1917 <sup>2</sup> .....		233,000	130	3,600,000			

<sup>1</sup> A by-product of sugar making. Figures for molasses for 1911-1914 are taken from reports of the Louisiana Sugar Planters' Association.

<sup>2</sup> 1917 figures are preliminary; they are based upon estimates made before the close of the season and hence are subject to revision.

and a further increase was made in 1917. At this rate of increase, the area would soon equal that of 1911 (310,000 acres), and the total output of Louisiana would be expected to range from 250,000 tons in a very unfavorable year to nearly 450,000 tons under the best of crop conditions. (See Table 4.)

Louisiana now produces about 95 per cent of our domestic cane sugar, a large fraction of which is sent as raw sugar to the refineries to be refined and granulated; while the rest of the Louisiana product consists of high-grade sugar, fit for immediate consumption. These higher grades of sugar are not all white granulated, but include light yellow sugar.

In 1911 the sugar classed "raw" amounted to 72 per cent of the total output, and the better grades equaled 28 per cent, according to published statements. Three years later, in 1914, the higher grades constituted 59 per cent of the total, but they declined to 47 per cent in 1915, and to 35 per cent in 1916.

As far as area is concerned it is entirely feasible, as has been pointed out, to increase the acreage of sugar cane in Louisiana. There are other factors, however, to be discussed later, which make it probable that the expansion will not be great in 1918, although a greater yield per acre should be obtained. In some of the other Southern States, notably in Texas, many more acres can be planted so far as suitable land and temperature are concerned. The most serious handicap in Texas, however, is the lack of irrigating facilities. Only about 10,000 acres are now devoted to cane cultivation in that State. However, several private companies have plans under way to expand and develop these facilities and thereby extend the cane-growing areas in southern Texas.

For 1918 the acreage of cane planted must depend upon the amount of seed cane that was banked last fall, and since it takes about a car-load for 5 acres, worth at present prices around \$200, the grower naturally did not bank last autumn any more seed cane than he was fairly sure he would use next spring. Unfortunately the severe freeze in the cane belt last October reduced the amount of cane banked for next year's planting to an amount considerably below expectations. Hence it is improbable that there will be any material expansion in the sugar-cane acreage in this country in the immediate future. This is especially true since our quarantine laws prevent us from importing cane for seed or other purposes from other countries on a commercial scale. The reason for this law is that there are in some of the other cane-producing countries very injurious insect pests and fungous diseases that have not been found in this country, and these very probably would be brought in if the importation of cane were permitted on a commercial scale. For this reason all cane brought

into this country must be grown for a time under strict quarantine. If under quarantine conditions it is found free from injurious pests and diseases it may be distributed to suitable areas. If it is found to be infested it is destroyed.

### **MORE AND IMPROVED MACHINERY.**

As with most crops, the use of more and improved machinery tends to cut down the cost of production of sugar cane and to make it possible to devote a larger area to the crop, using the labor available. Improved methods of growing have been accompanied by improved machinery, both for handling the crop in the field and in the mill. Labor-saving implements, such as tractors, harvesters, loaders, etc., offer considerable encouragement to the grower in his effort to increase the cane acreage, or to accomplish more with a given amount of labor.

### **BETTER CULTURAL PRACTICES WITH SUGAR CANE.**

In the growing of cane much can be done to improve the stands by a better preparation of the seed bed, by crop rotation, and by the control of pests. The seed bed should be plowed to good depth well in advance of the planting. It should be thoroughly worked until firm and smooth and should be well supplied with humus and with available plant food. Cane land should not be replanted continuously with cane. Other crops should be grown at frequent intervals, and these rotating crops should include a legume that should be plowed under for soil improvement. The introduction of more live stock to utilize the cane leaves and to make manure available also is an improvement factor in soil improvement.

### **IMPROVED VARIETIES OF SUGAR CANE.**

In considering the future of the cane-sugar industry the matter of new and improved varieties should not be overlooked. These may be obtained by importing promising varieties of cane not now grown in this country or by developing new varieties by producing and planting the seed, which matures in this country only under hot-house conditions. In the tropics the seed of the cane sometimes matures in the open; hence, it is from the tropical countries that we expect to obtain most of our new varieties. The promising new varieties are being tried out in this country as rapidly as they can be obtained. There is a wide difference in existing varieties, both with reference to quality and their ability to resist the attacks of insects and diseases. While this line of work does not promise immediate results it is of such great importance that it should receive the



most earnest attention, especially at this time when increased yields of cane and sugar contents are so important.

### INSECTS AND FUNGI CURTAIL CANE CROP.

Sugar cane is attacked by fungous diseases and insect pests which at times constitute a limiting factor in the size of the cane-sugar output. Some of these are easily controlled, and every effort should be made to reduce the toll which they collect. The new areas planted to cane are dependent to a great extent upon the amount of seed cane that is carried through the winter months in good condition. The most serious disease in this country is the red-rot, which is caused by a fungus. It is an especial menace, since it sometimes becomes very destructive in the banks where the seed cane is stored and thus destroys or threatens to destroy a large amount of seed cane. As a precaution against red-rot and other destructive fungous diseases, seed cane should be selected with more than ordinary care and as far as possible in areas free from diseases and pests.

Another heavy loss in sugar-cane production is sometimes caused by the moth borer, commonly known as the "borer." When most numerous and active it has been estimated to reduce the sugar-cane crop as much as 1,000 pounds per acre. The annual loss, especially at present prices of sugar, over the 300,000 acres infested in Louisiana, is startling.

This borer in the adult stage is a small, straw-colored moth. It is in the larva stage, however, that it works its injury by boring or tunnelling through the stalks of cane. In the same way it attacks corn. Some years ago, the eggs of this moth were found to be destroyed by a minute, wasp-like parasite. The Government entomologists immediately realized that the universal practice of burning the leaves cut from the sugar cane and left on the fields after the removal of the cane stalks probably causes the death of vast numbers of these beneficial insects. Experiments were started in which the leaves were not burned, but were plowed under, and on isolated areas the infestation was found to be greatly reduced. In most of the sugar section, however, the fields of cane and corn are almost continuous, and non-burning practiced on a single plantation usually neither increases nor decreases the infestation. An effort is now being made to extend the practice of plowing under the leaves to several large groups of plantations. The plowing under of the mass of vegetable material left on the fields adds fertilizing elements to the soil, a saving which more than pays for the slight additional labor in cultivating fields on which the leaves have been left.

To supplement the work of this native parasite, the Government entomologists have attempted the introduction of beneficial insects

from Cuba. Results sufficiently favorable to indicate that the work might eventually be successful were obtained in 1915.

### ORIGIN AND EXPANSION OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES.

The first beet-sugar mill in the United States was built at Northampton, Mass., in 1838, and in 1839 that mill turned out 1,300 pounds of sugar. This mill and the 12 subsequently erected mills, built in six States between 1838 and 1868, were commercial failures. The real beginning of the American beet-sugar industry was marked by the erection of a mill at Alvarado, Cal., in 1869, and even this mill passed through a 10-year period of uncertainty before the beet-sugar industry was permanently and successfully started in this country. During the 20 years that followed, 15 new mills were built. Thus the sugar-beet experiments and operations in this country have extended over a period of 80 years. The first half of this period, 1838 to 1878, was filled with experiments that resulted for the most part in commercial failures. The latter part of this period, to date, has witnessed a more or less steady growth of the industry, until now there is a total of 99 beet-sugar mills in this country, more than 80 of which have been built in the last 20 years. (See accompanying map.) Thus the industry is one of the newest of our large commercial agricultural enterprises, and for this reason much time, thought, and work must be expended upon it in making it fit into and become a part of our established agriculture, and in making it play its part in supplying the world with sugar.

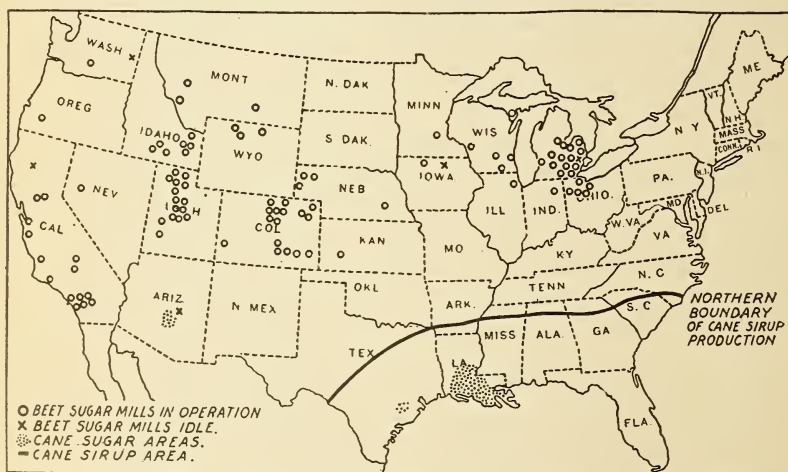


FIG. 2.—This map shows the location of the sugar beet and sugar cane areas in the United States. Beet sugar mills in operation in 1917 numbered 94; five mills were idle, making a total of 99. As sugar beet growing depends upon the accessibility of a mill, the circles show where beets are grown at present.



TABLE 5.—*Sugar beets and beet sugar—acreage and production in 1912-1917.*

[Figures for 1917 are based upon returns made before the end of the season, and are subject to revision.]

State and year. <sup>1</sup>	Factories in operation.	Sugar made.	Average ex- traction. <sup>2</sup>	Beets worked in factories.		Average farm price of beets per ton.
				Area harvested.	Quantity worked.	
	<i>Number.</i>	<i>Short tons.<sup>3</sup></i>	<i>Per cent.</i>	<i>Acres.</i>	<i>Short tons.<sup>3</sup></i>	<i>Dollars.</i>
<b>California:</b>						
1917.....	14	200,100	15.18	154,700	1,318,400	7.52
1916.....	11	236,322	16.15	141,097	1,462,895	6.30
1915.....	11	195,343	15.64	122,737	1,249,111	5.86
<b>Colorado:</b>						
1917.....	16	247,500	13.36	162,000	1,853,200	7.24
1916.....	14	252,147	13.04	188,568	1,933,591	6.06
1915.....	14	273,780	14.49	171,222	1,888,860	5.88
<b>Idaho:</b>						
1917.....	7	43,500	13.19	38,600	329,800	7.00
1916.....	5	45,874	13.84	42,135	331,478	6.16
1915.....	4	51,225	15.07	35,068	339,859	5.08
<b>Michigan:</b>						
1917.....	15	80,600	13.51	86,000	596,500	8.00
1916.....	15	69,341	13.79	99,619	502,705	6.14
1915.....	15	129,997	13.03	122,000	997,972	5.91
<b>Ohio:</b>						
1917.....	5	30,400	12.55	26,100	242,300	7.27
1916.....	4	18,234	13.24	24,767	137,696	6.83
1915.....	4	33,472	11.98	25,684	279,427	5.29
<b>Utah:</b>						
1917.....	15	103,000	13.27	81,300	776,400	7.00
1916.....	11	90,277	12.75	68,211	708,237	5.73
1915.....	8	85,014	13.51	56,226	629,204	4.91
<b>Other States:</b>						
1917.....	22	143,700	12.82	126,700	1,120,500	7.28
1916.....	14	108,462	12.87	100,911	843,071	6.18
1915.....	11	105,389	13.76	78,364	765,860	5.67
<b>United States:</b>						
1917.....	94	848,800	13.61	675,400	6,237,100	7.34
1916.....	74	820,657	13.86	665,308	5,919,673	6.12
1915.....	67	874,220	14.21	611,301	6,150,293	5.67
1914.....	60	722,054	13.65	483,400	5,288,500	5.45
1913.....	71	733,401	12.96	580,006	5,659,462	5.69
1912.....	73	692,556	13.26	555,300	5,224,377	5.82

<sup>1</sup> Acreage and production of beets are credited to the respective States in which the beets were made into sugar.

<sup>2</sup> Based upon the weight of the beets.

<sup>3</sup> A short ton is 2,000 pounds.

Sugar beets are now grown commercially in 19 States lying in the northern and western part of the United States. (See Table 5.) The sugar-beet producing States extend from Michigan and Ohio on the east to California on the west, and lie north of a line drawn from southern Ohio to the lower part of California. Sugar beets will grow south of this line, but except for certain elevated positions the climatic conditions do not seem to favor the formation and storage

of sugar in the beet. There are many areas within the 19 sugar-beet raising States in which the soil and climatic conditions favor their profitable production. The same is true of the States lying east of Michigan and Ohio as well as States between and adjacent to the States which at present grow sugar beets. The States producing beets, from the standpoint of acreage and mills, are divided naturally into four groups. In the eastern or north central group of States, Michigan leads with 15 sugar mills. This group of States, in which sugar beets are grown under rainfall conditions, extends from Michigan to the Missouri River. West and southwest of the Missouri River sugar beets are grown under irrigation only. In the central group of States Colorado leads with 16 sugar mills. This group embraces Colorado, Wyoming, Montana, Nebraska, and Kansas. The intermountain States, from the standpoint of sugar-beet culture, include Utah and Idaho, with 22 sugar mills in operation and several others in the process of construction. To this group the States of Washington and Oregon, with 1 sugar mill each, are attached. The Western sugar-beet area embraces California, which contains 15 sugar mills. In these 4 divisions are located the 99 beet-sugar mills, which are capable of producing upward of 1,000,000 tons of sugar annually. The entire output of beet sugar made in this country is refined and ready for consumption when it leaves the mills and amounts annually to about three times as much as the output of cane sugar. (See Tables 4 and 5.)

Preliminary returns to the Bureau of Crop Estimates from practically all operating beet-sugar factories in the United States indicated a production of 848,800 short tons of sugar during the 1917 season, compared with \$20,657 for 1916. The area harvested in 1917 was estimated to be 675,400 acres, compared with 665,308 acres in 1916. The estimated planted acreage in 1917 was 806,600, of which 131,200 acres or 16 per cent, according to these preliminary reports, yielded no beets for sugar making. There were 94 factories in operation in 1917, or 20 more than in 1916.

#### EXPANDING THE SUGAR-BEET ACREAGE.

In each of the 19 States now producing sugar beets there are larger or smaller areas which are capable of producing sugar beets, and in which this crop is not grown. These areas in part are under cultivation and in part undeveloped. The present sugar-beet acreage, as far as the availability of the land is concerned, may be expanded either by injecting sugar-beet culture into the present farming operations, where practicable, or by the development of new areas, not hitherto devoted to crop production. In the present sugar-beet areas, moreover, very few of the sugar mills are operating to

full capacity, for lack of sufficient raw material. In fact, a number of sugar-beet mills operated to one-half of their capacity or less during the past season because of a lack of an adequate supply of beets. Thus it is evident that in the vicinity of these mills there is ample room for the expansion of the sugar-beet industry.

Reference has been made to the possibility of utilizing hitherto untilled areas, as a means of expanding the sugar-beet acreage. This may be done by bringing in land through drainage, through the extension or development of irrigation systems, or through the cultivation of lands that are now in the raw state. Within the last year large areas of Indian lands not formerly cultivated have been leased and prepared for sugar-beet culture. Plans are under way still further to increase the sugar-beet acreage by the utilization of other Indian lands in Wyoming, Idaho, and Montana.

#### **SUPPLY OF SEED IS AN IMPORTANT FACTOR IN BEET ACREAGE.**

The seed supply, ever an important factor, is doubly so at this time. Previous to the war the United States was dependent almost entirely upon foreign countries for sugar-beet seed. At that time nearly all imported beet seed was obtained from German growers or dealers. In the course of events this source was shut off and the only foreign country from which we can now obtain any considerable quantity of sugar-beet seed is Russia. Nearly all the imported seed used for the 1916 and 1917 planting over and above the small surplus left over from previously imported lots came from that country. When it became apparent that a shortage of sugar-beet seed might result from the great war, the production of sugar-beet seed on a commercial scale in the United States was undertaken. This undertaking is three-fold: First, to produce a commercial quantity of sugar-beet seed immediately; second, to build up a permanent beet-seed industry; and, third, to develop improved American strains of sugar beet and to expand those strains into our commercial production.

As a result of these efforts to produce commercial quantities of sugar-beet seed in the United States, several beet-sugar companies and one large beet-seed company are producing sugar-beet seed to the extent of from 25 per cent to 40 per cent of the annual requirements of the American beet growers. These growers are establishing their beet-seed business on a permanent basis, and improved strains of sugar beets are in process of development. It is confidently expected that within a few years all the beet seed required by American growers will be produced in this country. The Department of Agriculture is confident that there is enough beet seed in the country to meet the needs next spring of all farmers wishing to grow sugar beets.



One of the reasons why the sugar-beet seed has not been produced before in commercial quantities is the expense and the possible loss of the roots from decay. Two growing seasons are required to produce a crop of seed. The first season the roots are grown. These must be stored during the winter and replanted early the next spring to grow the seed. These seed roots must be selected with care and only the best used, in order to maintain those qualities, sugar content and purity or freedom from mineral salts, that render the roots profitable for sugar production. Furthermore, the seed must be gathered by hand. This is an expensive operation, but absolutely necessary under present conditions, owing to the uneven ripening of the seed, in order to prevent a loss of a portion of the seed by shattering. Sometimes from two to four cuttings over the field are necessary in order to avoid cutting some of the plants when either too ripe or too immature.

#### LABOR-SAVING DEVICES TO INCREASE BEET ACREAGE.

The problem of maintaining or increasing the present sugar-beet acreage in the established sugar-beet areas presents many problems which to a considerable extent will have to be solved locally. In some regions as large a proportion of the tillable land as is available is already in beets, and to increase the acreage might unbalance the rotation system on the farms and thereby do serious injury to the agriculture industry.

Another problem is the supplying of ample labor at the proper time. The peak of the labor load usually comes at thinning and again at harvest time. Sugar-beet seed is planted in solid rows and when the plants are up and have from four to six leaves they must be blocked and thinned. The blocking consists in cutting out a large number of the plants, leaving the remaining plants in hills or tufts at intervals of 8 or 10 inches in the row. The blocking is usually done by means of a hand hoe. After blocking, each hill or tuft must be thinned by hand to one plant. While this work is not heavy it requires a large number of workers, since it must be accomplished while the plants are small.

In those localities in which the acreage of beets per farm is small, the blocking and thinning are sometimes done by the farmer who has contracted to grow beets, assisted by his family. In many cases, however, especially where the beet acreage is large, extra labor must be employed.

Efforts are being made to develop a sugar-beet seed planter that will drop the seed in hills, thus eliminating the work of blocking or thinning the plants in the row. Owing to the multiple nature of the beet seed, however, it still will be necessary to continue hand thinning in the hills, at least until a single-germ beet seed is developed

in commercial quantities. The hill planter when perfected and placed on the market, it is claimed, not only will do away with the blocking, as already stated, but also will make it feasible to plant an acre of beets with less seed. Until this planter is perfected, however, hand labor for thinning the beets must be provided. Furthermore, a large amount of labor is required in harvesting the beet crop.

Harvesting sugar beets consists of several distinct operations, namely, lifting, pulling, topping, and hauling. Lifting is done by an implement somewhat resembling a plow and simply loosens the beets. They are then pulled by hand and thrown in piles and each beet is topped by hand by cutting off the crown at the point of the lowest leaf attachment. The roots are then forked onto a wagon and hauled to the mill or loading station. Recently several beet-harvesting machines have been offered on the market and it is hoped they will prove satisfactory and be available in sufficient numbers to handle a part of the 1918 crop. This should have a beneficial effect in maintaining and expanding the present sugar-beet acreage, since the harvesting of the crop is the most laborious and the most expensive operation in its production.

#### **BETTER CULTURAL METHODS WILL INCREASE THE BEET CROP.**

Even without the expansion of the sugar-beet acreage, sugar-beet production is capable of being increased by closer attention to the details of crop production, thereby increasing the yields of beets per acre. In all parts of the sugar-beet area the stands of beets at harvest time are often far from perfect, as indicated by the low average yield of about 10 tons per acre, and frequently the beets themselves are not as large and as well shaped as they should be. This is due in part to the lack of preparation of the seed bed.

Preparation for the next year's crop should be begun in the fall by plowing it to a good depth, care being taken not to bring too much raw soil to the surface. In the irrigated areas the ground should be watered, if practicable, during the winter, unless there is sufficient rain or snow to moisten and firm the seed and root beds. In any case the ground should be worked in the spring until it is smooth and firm, so that the drill will plant the seed at a proper and uniform depth. The rows should be straight, to facilitate cultivation and harvesting. As soon as the beets have from four to six leaves they should be blocked and thinned with a hoe. This work should be done with care, so that the beets which are left to form the crop will be disturbed as little as possible, and will stand the proper distance apart in the row. In the subsequent hoeings care should be exercised so that none of the beets are cut off or injured by the hoe, and in cultivating



the proper attachments should be used each time and the work done with such care that none of the beets are covered up or cultivated out of the soil. Usually the four-row cultivator is used, and if it is allowed to swerve and cut one or more beets from each of the four rows the stand is correspondingly damaged.

In the irrigated areas beets frequently suffer because of the way in which they are watered. Sugar beets should never be flood-irrigated, for the reason that flooding is wasteful of water, that it almost always destroys some plants by washing them out, and that it injures the remaining plants by preventing a free circulation of air around their roots. The water should always be applied in furrows between each row or between every other row, and allowed to flow at so slow a rate that the ground will not be washed, and for a sufficient length of time for the soil to be thoroughly wet. Furrow irrigation enables the grower to avoid the crust formation around the plants which so often follows flood irrigation. As soon as possible after the field is irrigated, the cultivator should be used, in order to form a proper mulch and thereby retard evaporation.

#### **LIVE STOCK PRODUCTION WITH SUGAR-BEET GROWING.**

The utilization of sugar-beet by-products such as the tops and crowns of the beets which are removed in the field, the wet pulp which is left after the sugar is extracted and is available at the sugar factories, and the dried pulp sold both at the factories and by feed dealers is of prime importance to the beet grower. Its use as a stock feed allows him to combine beet production with live stock farming and thus make a profit from the animals and at the same time improve the fertility of the soil through the application of manure which is the most satisfactory form of fertilizer for sugar beets.

#### **BEEF TOPS AND CROWNS.**

The weight of leaves and crowns produced per acre varies greatly in different parts of the country as well as from season to season. An average weight of 4 tons per acre, however, is a conservative estimate. Of this quantity about one-fourth, or one ton per acre, is crowns, and the remaining three-fourths are leaves. At that rate the total yield in the United States for 1917 would amount to about 2,700,000 tons. At present only a small part of the beet tops produced are used as feed and much of the profit that could be made from them is lost by plowing them under as fertilizer.

The usual methods of handling tops and crowns is by turning stock into the field to do their own foraging, to feed the cured product in the farmyard, or to place it in the silo. The turning of sheep

or other stock into fields after the roots have been hauled to the factory saves the labor of handling the feed, but it is wasteful, since much of the material is trampled upon and not eaten. When the tops and crowns are dried they lose about 75 per cent of their original weight and average about a ton to the acre, which in feeding value is about equal to the same amount of first-class hay.

Where beet tops are siloed or placed in pits, especially in dairy sections, other materials which will take up excess moisture, such as chopped corn stalks or oat straw, are mixed with them. The layer of leaves should be sprinkled with salt, using from 6 to 8 pounds per ton of leaves. Siloed in this way the material should keep in a satisfactory condition for several years. Estimating the value of beet tops at \$6 per acre the total value of this by-product in the United States exceeds three million dollars.

In feeding beet-top silage to dairy cows it frequently composes as much as one-third of the ration, and when fed to steers even more is given. Because of the oxalic acid contained in the silage, however, about one-fourth pound carbonate of lime should be fed to each 250 pounds of silage, since the lime neutralizes the action of the acid.

#### WET BEET PULP.

The wet beet pulp which is left after the sugar is extracted constitutes about 80 per cent of the weight of the beets. The crop of beets in 1917 was approximately 6,237,000 tons, which yielded about 4,990,000 tons of wet pulp. This was available either in the form of wet pulp, which often is furnished gratis by beet factories to their patrons or sold at a nominal price, or to be dried and sold as a stock feed, either with or without the addition of molasses.

Care should be taken in feeding fresh pulp, since it spoils rapidly on exposure to the air. Most of the pulp is therefore fed as a soured or ensiled pulp. When fed near the factories the pulp is dumped in large, well-drained pits, or trenches, or into huge tank-like silos built chiefly above the ground. A method sometimes practiced by the farmer is to pile the pulp in large heaps when the outside layer of pulp will protect the interior from the air.

Animals eat the sour (siloed) pulp as well and, after a little time, even better than they do the pulp fresh from the factory, and the dried beet chips on the surface of the piles are more palatable for both sheep and cattle. The farmer who is near a factory and has the appliances so arranged that he can handle the wet pulp with the least expense should make the greatest use of pulp and will gain the greatest profit from its use. If it can be placed before the stock at a cost of not more than \$1 a ton it will bring good returns on

the investment and in many instances it may be worth two or three times this amount.

The New York Experiment Station at Cornell found that cows will eat from 50 to 100 pounds of fresh beet pulp per day, in addition to 8 pounds of corn and 6 to 12 pounds of hay. The dry matter in wet beet pulp proved equal to that in corn silage. The Colorado Experiment Station has estimated that 1 ton of wet beet pulp equals 220 pounds of corn or 620 pounds of alfalfa for fattening steers.

#### DRIED BEET PULP.

Owing to the high prices of concentrate feeds and the favor with which wet beet pulp was received by stockmen, many sugar-beet factories have been equipped with facilities for drying the pulp so that it contains only 8 to 12 per cent of moisture. Dried beet pulp absorbs a great deal of water and should be moistened with two or three times its weight of water before being fed, as unless so handled it is likely to cause clogging, indigestion, and stomach irritation. As a supplement to pasturage a ration of one-half dried pulp and one-half gluten feed; or one-third dried pulp, one-third gluten feed and one-third wheat bran have proved to be desirable combinations. As high as 8 pounds of dried pulp well moistened with water may be fed to each animal as a partial source of roughage in place of corn silage, together with all the hay the animal will eat. In a test with corn meal ration, the corn meal produced 2 per cent less milk than the plain pulp ration, and in a second trial the corn meal ration gave an increase of some 3 per cent of milk over the molasses pulp ration. From this one may conclude that the corn meal and beet pulp as components of a ration have about the same effect. Therefore if the dried pulp can be procured at slightly less per ton than the corn meal it would prove economical for dairy animals.

Another test compared the dried beet pulp with corn silage. It was concluded that the dried pulp ration gave 10.2 per cent more milk than did the silage ration; but because of the cost of the dried pulp it is more economical to farmers to feed silage, although it takes from 5½ to 6 tons of silage to equal the feeding value of one ton of dried pulp. In still another experiment dried beet pulp was found to compare favorably with corn meal for fattening sheep and steers. It procured larger gains with growing animals, while corn meal put on more rapid gains with fattening animals near the finishing period.

Farmers who are in a position to produce their feed cannot afford as a rule to purchase starchy feedstuffs, of which dried beet pulp is a type. Such material should be produced upon the farm in the form of corn, oats, and barley. For milk production it is more desirable



for the farmers to purchase materials rich in protein such as cotton-seed and linseed meals, distillers' and brewers' dried corns, gluten feed, malt sprouts, fine middlings, and wheat bran. Only when the supply of home-grown corn is exhausted or limited would it be considered economical to substitute dried beet pulp either as a portion of the corn ration or as a part of the roughage. However, the milk producers who purchase a large part or all their feed will find the dried pulp a satisfactory component of the daily ration, provided it can be secured at a relatively reasonable price.

Pulp supplies a succulent food at a time when such food is either not available or is scarce, and its effect on the stock seems to be much more favorable than either its chemical analysis or the return in increased meat and milk would indicate. Pulp undoubtedly overcomes much of the injurious effects of dried and concentrated foods, puts the system of the animal in good condition, and aids the appetite and in the digestion and assimilation of food, so that there is less waste both of food which is generally discarded in eating and that which usually passes through the animal undigested.

#### BET MOLASSES.

Feeding molasses to stock has been practiced in Europe for nearly 100 years, and yet large quantities of this so-called refuse material have not been fed in this country because stockmen who might have utilized it did not realize its value. The molasses from beet sugar factories is a carbonaceous feed containing about 66 per cent of nitrogen-free extract which is about 80 per cent sugar. Its feeding value is about three-fourths that of corn. When fed in too large amounts it is very laxative on account of its high content of alkaline salts. Animals, therefore, should be accustomed to the molasses gradually and care should be taken not to feed too large an allowance. The maximum amount of molasses advised by various authorities for animals accustomed to the feed is for dairy cows from  $2\frac{1}{2}$  to 3 pounds and for fattening cattle from 4 to 8 pounds. It may be dried with beet pulp, forming a molasses-beet pulp by-product which is somewhat more palatable and digestible than the ordinary dried beet pulp and has equal or slightly higher feeding value. It may be mixed with alfalfa or other material for feeding purposes, or by simply diluting it with about twice its volume of water it may be fed by itself or sprinkled upon hay or other dry fodder. The quantity of molasses to be used per day depends upon the kind of stock to which it is fed. In beginning its use as a part of a daily ration it is advisable to start with about one-fourth of the desired quantity and gradually increase the amount from day to day until the full ration is reached.

#### LIME CAKE.

Another by-product of the sugar beet factory of value to the farmer is the lime cake produced by the use of the milk of lime in the beet juice to assist in the crystallization of the sugar. After the lime has been combined with certain substances in the beet juice the liquid containing the sugar is pressed through filter cloths, the lime cake remaining behind. As yet comparatively little use has been made of this by-product in this country, though in Europe it is in general use as a fertilizer. It is especially recommended in the case of acid soils and hard soils that need some material to make them more friable.

It is evident that a substantial profit can be added to the returns from the sale of sugar beets by the full utilization of the by-products of the crop. Not only are the immediate cash returns increased by the use of these by-products but the soil is improved, thereby increasing the yield of crops grown in rotation with sugar beets.

#### AVOID THE TOLL OF INSECTS AND DISEASES.

At this time more attention than usual should be paid to the losses caused by diseases and insects which attack sugar beets. In times when labor is scarce and a minimum of work is expended upon crops the toll of insects and diseases is likely to be heaviest. Unfortunately, with beets, these enemies are ever alert. Some of these pests may attack the beets when they are small, while others do not become troublesome until the beets are well advanced or nearly grown. For example, the damping-off disease due to fungi is destructive when the beets are small, if at all, and, likewise, the cutworms or wireworms do their most destructive work soon after the beets are up. Certain diseases such as leaf-spots due to fungi usually do not occur until near midsummer, when the plants are well advanced, while the root-rots usually do not become noticeably serious until the plants are from one-half to two-thirds grown. Some leaf-eating pests, such as webworms and armyworms, sometimes do considerable damage by eating the beet leaves in midsummer when the plants are partly grown, thereby reducing greatly the yield of beets and of sugar per acre. The biting insects may generally be controlled by the use of poison sprays or by poisons applied in some suitable form.

While all of these and some minor pests attack the sugar beet, one of the most destructive pests to be guarded against is the sugar-beet nematode. This pest is not yet general over the sugar-beet area, but is found in several of the Western States, where it does damage to the extent of several hundred thousand dollars annually. When the soil becomes infested with this nematode, commonly known as the



eelworm, it attacks the roots of plants, especially the sugar beet, and causes it to wilt and to cease to grow. The only practical remedy known at present is crop rotation. While there are many plant species upon which the sugar-beet nematode will live, there are some plants, especially the small grains and beans, upon which it does not live or upon which it does not thrive. By growing these crops for several years upon the infested land, nematodes may be reduced in number so that profitable crops of beets may be grown again. In general, crop rotation is a safeguard against the establishment and propagation of many plant pests, and may be used to advantage in the control not only of nematodes but of leaf-spot, root-rot, and other diseases of the sugar beets.

### PRICES OF RAW AND REFINED SUGAR ESTABLISHED.

The Act of Congress, signed by the President on August 10, 1917, entitled "An Act to provide further for the national security and defense by encouraging the production, conserving the supply, and controlling the distribution of food products and fuel," made it possible for the Food Administration, under authority of the President, to enter into arrangements to control the price and movement of sugar in the United States. In order to carry into effect the purposes of the Act it was found necessary, on October 1, to license the importation, manufacture, and refining of sugar, sugar sirups, and molasses.

In order to secure a just price to the producers of sugar beets and sugar cane and at the same time to keep prices to consumers from advancing too high, the Food Administration early last summer took steps to arrive at an agreement between the growers, the sugar refiners, and the Administration. The beet-sugar manufacturers agreed with the Food Administration to sell beet sugar on a cane basis of \$7.25 per 100 pounds at seaboard points. Under this agreement, therefore, the price to the wholesale trade at interior points was set at \$7.25 per 100-pound sack, plus freight charges from New York, New Orleans, San Francisco, or other seaboard points.

The refiners of cane sugar agreed with the Food Administration to refine sugar on a net margin between cost of their raw material and the selling price of their refined product of approximately 1.3 cents per pound, after the trade discounts had been deducted.

The Western cane-sugar refiners, who joined with the beet producers of the country, made it possible to establish the price for cane sugar for the western half of the United States at not to exceed \$7.25, cane basis, seaboard refining points. This agreement made it possible to name the same figure for the beet sugar produced in this country and also the Hawaiian cane. The price of the Louisiana sugar-cane crop was next set at \$6.35 for 96 per cent test raw sugar at New Orleans

and seaboard refining points. This meant that refiners buying this raw sugar at about \$6.35 would be allowed an average margin of not to exceed \$1.30 per 100 pounds for refining the product. It was later announced that a fair profit would be earned by all producers of direct-consumption sugar in Louisiana, such as washed and clarified, if their produce sold at not to exceed \$7.25 per 100 pounds, less two per cent, New Orleans basis. This, of course, does not apply to refined sugars or plantation granulated sugars, the prices for which are controlled under agreements between the Food Administration and the refiners. The planter was notified that he should not sell sugar above \$7.25 to the dealer or jobber, New Orleans basis, and that the selling price to manufacturers or retailers should not exceed the base price, plus the usual freight to destination, plus the profit charged by sugar jobbers in the territory in which sold, which in no case is to exceed 25 cents per 100 pounds.

On December 11 it became necessary to raise the price of beet sugar from \$7.25 to \$7.35. This was due to the price agreed upon by the representatives of the Cuban government and the Food Administration for Cuban cane sugar; and it was anticipated that another advance in price might be made after the Cuban freight rates had been finally adjusted. On December 28 it was known that with the price of \$4.60 f. o. b. Cuba and the rates for freight established, the basis for refined sugar in New York would be \$7.45, less 2 per cent. On January 7 a uniform price for both beet and cane was made at this amount, with the exception of Louisiana, their price not being changed as yet.

### OUR LARGE CONSUMPTION.

Habit apparently helps to develop a "sugar tooth." Sugar consumption has increased steadily in practically all of the important sugar-consuming countries and, taking the world at large, sugar production means sugar consumption. Normally a considerable quantity is held in stock in the world, but consumption has kept pace with the expansion of production.

Stocks of sugar carried over from one year to another, of course, vary in size and also in location. Hence it is not always possible to arrive definitely at the actual consumption of sugar in a country within a single year. In order to find just where the United States stood in regard to sugar stocks the item of sugar was included in the War Emergency Food Survey of August 31, 1917, made by the United States Department of Agriculture. This survey brought out the fact that the estimated stocks of sugar in commercial channels on August 31, 1917, were about 1,500,000,000 pounds, compared with 2,000,000,000 pounds on August 31, 1916. The amount of sugar in various channels of trade, shown by the inventories for 1917 and 1916, added to the

available supply for 1917, makes it possible to determine that the amount of sugar actually consumed for the year ending August 31, 1917, was approximately 9,100,000,000 pounds, or 88.3 pounds per capita. In the absence of inventory figures for August 31, 1915, it was not possible similarly to determine the amount consumed in 1916. However, the average annual consumption of the five-year period ending in 1916 was 8,300,000,000 pounds, or 84.7 pounds per capita. It is thus apparent that there has been a considerable increase in the consumption of sugar. One of the causes of this was the increased use in canning last fall. Other causes contributing to the heavy demands upon our large stocks were the normal increase in the population of the country, coupled with an increased per capita consumption of sugar, and an increase in consumers' stocks. The survey also showed that the stocks of sugar reported for August 31, 1917, were much farther along on their way from producer to consumer than those reported for 1916.

The United States has been increasing its consumption of sugar steadily for years and we scarcely realize what the curtailed use of the sugar means. The War Emergency Food Survey proved that there was enough sugar consumed in the United States for the year ending August 31, 1917, to give each man, woman, and child 88.3 pounds of sugar. Of course, this was not all consumed as sugar in the home, since a large proportion is utilized in the manufacture of candy, bread-stuffs, and many other ways—but it was consumed nevertheless. The United States Food Administration has estimated that the amount actually consumed in the home was about 55 pounds per capita in 1917. What this large consumption means can be understood only by comparing it with that of some other countries which before the war also had large sugar bowls which they kept full. (See Table 6.)

TABLE 6.—*Per capita<sup>1</sup> consumption of sugar, 1909-1913.*

	<i>Pounds.</i>
United States .....	81.6
United Kingdom .....	87.94
France .....	39.15
Italy .....	10.10
Belgium .....	30.40
Russia .....	15.82
Germany .....	39.77
Austria-Hungary .....	29.72
Denmark .....	84.40
Sweden (1911-12 only) .....	63.20
Norway (1912-1914) .....	44.27
Australia .....	112.06

<sup>1</sup> This includes besides the sugar consumed in the home, that utilized in *bakery shops*, candy factories, and in the manufacture of various commodities.

<sup>2</sup> Five years ending August 31, 1913.



In France the amount of sugar allowed to each person for household use is now limited to 13.2 pounds per year. In England 24 pounds of sugar per person for home use is all that is allowed. We are thus literally using four teaspoonfuls of sugar to the Frenchman's carefully conserved one and two teaspoonfuls to the Englishman's one. Such extravagance of consumption as we have been used to in the recent past surely should make us thoughtful while handling the sugar spoon. If it is not dipped daily so deep or so often by more or less of 103,000,000 people—including you and me—more sugar can be sent to the Allies and to our soldiers. It is idle to compute how much the saving would be, as it depends largely upon how successful we are in arresting the spoon while on its way to the sugar bowl. Each dip of that spoon means the withdrawal of a bit of energy which might find its way to the trenches.

Sugar ordinarily would not be considered a war food; it is usually regarded as a luxury. To the soldier, nevertheless, sugar is a necessity; it is a great energizer, is digested rapidly, assists in warding off fatigue, and is a great heat producer. For these and other reasons the civilian population of England, France, and Italy have stinted themselves to the limit in order to divide generously their meagre sugar supply with the men in the armies.

#### **SUBSTITUTES FOR REFINED BEET AND CANE SUGAR.**

One of the ways of meeting the current situation is by increasing the production of sugar. That has already been discussed. Curtailing consumption is the alternative; and this may be done either by actually consuming less sweets or by eating more substitutes for beet and cane sugar. Refined sugar is more readily handled and transported than many of the substitutes which now are eaten in great quantities, such as maple sugar and sirup, honey, cane sirup, sorghum sirup, cane molasses, and glucose or corn sirup. Because the substitution of these and other sweets releases much sugar for other uses all such substitutes should be produced in larger amounts this year.

The maple sugar and sirup industry is much more extensive and important than is generally supposed. It extends from Maine southward to Kentucky and westward to Minnesota, and maple sirup and sugar are produced commercially in 19 States. Nearly 19,000,000 trees are tapped annually, from which more than 14,000,000 pounds of sugar and more than 4,000,000 gallons of sirup are made, which is equivalent to about 46,000,000 pounds of sugar. Add to this amount the honey crop of that year, 55,000,000 pounds, and we have a total of 101,000,000 pounds of sweet foodstuffs. The production of table sirup from sugar cane was about 23,000,000 gallons in 1909, while molasses, the residual product from cane sugar manu-



facturing, equalled 25,000,000 gallons. Imports of molasses averaged about 32,000,000 gallons, about half that amount being exported. This industry has increased in late years; in the fiscal year 1917, imports were 140,000,000 gallons and exports only 2,892,000 gallons.

Official figures are lacking for the quantity of glucose and grape sugar made in this country, but the Census gives the value of glucose as \$18,541,000, and of grape sugar as \$3,776,000. These two products are exported in large quantities, the amount of glucose, or corn sirup, for the fiscal year of 1917 amounting to 170,000,000 pounds, and of grape sugar about 45,000,000 pounds.

While the maple products are looked upon as luxuries, they are an important factor in our supply of sweets and are capable of considerable extension by utilizing the sugar bushes that ordinarily remain idle and by giving better care and attention to those that are used. It is true that much work is necessary in making maple sugar and sirup, but the work comes in the early spring before the regular farm work begins.

The honey industry is capable of great expansion by giving closer attention to the care and breeding of bees. See *Honey: More Honey Needed*, Circular No. 87, United States Department of Agriculture.

Cane sirup production in the United States will be limited in 1918 to the cane production from the stubble cane plus the seed cane now in banks ready to be planted in the spring. In general, however, cane sirup production may be greatly increased by increasing the area devoted to cane, by better cultural methods, by the use of improved varieties and by employing better milling methods.

Sirup from sweet sorghum is now made commercially in about one-half of the 48 States. Kentucky, Tennessee, and adjacent States form the present center of this industry. The area devoted to the crop for sirup production may be increased several fold in the States in which it is now produced, and the cultivation of sweet sorghum may be extended into nearly all the remaining States.

Large quantities of cane molasses are imported from the cane-sugar producing countries, especially from Cuba. This sweet is used in part as a food, but the larger part of it is devoted to the production of industrial alcohol. In a general way the production of cane molasses bears a close relation to the amount of cane sugar produced. The actual amount of cane molasses to a given amount of cane depends upon the quality of the cane and upon the working efficiency of the mill.

Glucose or corn sirup is a sweet that has found a place for certain purposes in many households. This compound is made by treating starch with mineral acid. In this country corn starch and hydrochloric acid are usually used in making glucose. The acid does not

seem to enter into the combination, but it brings about or assists in forming a chemical combination between the starch and water. In some countries starch from potatoes and other plants and sulphuric acid are used in the manufacture of glucose. The extent to which production of this sweet may be carried is limited only by the available supply of starch and acid. It is entirely possible that a part of the unusually large corn crop of the present year might be used to advantage in increasing this form of sweet, thereby conserving still further the more portable sweets for our soldiers and the Allies.

Grape sugar is closely related to corn sirup and is in fact the solid part formed in the process of making glucose or corn starch. The further the boiling process is carried the greater the amount of grape sugar produced. In general the possible production of grape sugar, like that of glucose, is limited only to the available supply of starch and acid.

In addition to these sweets, beet sirup deserves mention not only because of the comparative ease with which it is made, but because of its palatable and nutritious quality and the wide extent of country over which it may be produced. It is essentially a home product, limited only by the seed supply and by the inclination of those possessing a small piece of tillable ground to grow the beets.

### SUMMARY.

In summing up the problems of our sugar supply it must be remembered that sweets are a necessity at the front and in the home, and that refined sugar is the most economical form in which to transport sweets. The first problem, therefore, is to maintain and where practicable to extend our sugar production, and the second problem is to conserve the most portable form of sweets, refined sugar, by using so far as practicable other forms of sweets, thereby leaving more of the refined product for the soldiers at the front.

#### HOW TO MAINTAIN AND EXTEND THE DOMESTIC CANE-SUGAR SUPPLY.

(1) By extending the cane-growing areas to lands suitable for cane production.

(2) By better cultural methods in the cane areas, thereby increasing the yields of cane.

(3) By adopting a rotation system that will improve the soil and make possible better yields of all crops grown in the cane areas, including sugar cane.

(4) By the improvement of cane varieties through selection and breeding, thereby increasing the yield of cane and of sugar per acre.

(5) By the control of diseases and insects, thereby preventing the destruction of cane in the banks (for seed) and in the field.

(6) By utilizing to the best advantage the by-products (tops, leaves, bagasse, and molasses), thus increasing the returns from the cane crop.

(7) By combining live stock production with cane growing, thus utilizing tops and leaves for feed and increasing the supply of barn-yard manure.

(8) By developing and extending the cane-sirup industry to provide a substitute for sugar and thus conserve the supply. (Beet and sorghum sirups and corn sirup, honey, and molasses should be substituted frequently for refined sugar.)

(9) By improving the methods of making sirup so that a better and more uniform grade of sirup will be produced, a wider and a more constant market obtained, and more sugar conserved.

(10) By producing raw sugar suitable for many household purposes, thus further conserving refined sugar, the most portable form of sweets.

#### HOW TO MAINTAIN AND INCREASE OUR DOMESTIC BEET-SUGAR OUTPUT.

(1) By improving cultural methods, thereby producing and maintaining better stands of beets and insuring better yields per acre.

(2) By practicing proper methods of crop rotation and cultivation, thereby checking and preventing the ravages of insects and diseases and improving the tilth of the soil.

(3) By establishing a proper relation between sugar plants (beets or cane) and live stock, permitting the feeding of a larger supply of by-products (tops, pulp, and molasses), and the production of a larger supply of manure, which in time will result in larger crops of sugar plants.

(4) By establishing a proper relation between mill capacity and quantity of raw material produced, so that a maximum mill run will be possible.

(5) By bringing under cultivation suitable new areas not now productive, such as certain uncultivated Indian lands in Montana, Wyoming, and Idaho.

(6) By draining certain wet areas otherwise capable of producing profitable crops of beets.

(7) By developing new systems of irrigation in dry areas otherwise suited to sugar-beet culture and by extending established irrigation systems in irrigated areas where sugar-beet growing is or may be carried on profitably.

(8) By increasing the beet acreage in present beet areas by inducing more farmers to grow beets. (Almost none of the beet-sugar mills operating in 1918 will have a maximum amount of raw material).

(9) By harvesting the beets more carefully, so that there will be no waste of the sugar-containing part of the beet or of its by-product.

(10) By developing satisfactory seeding and harvesting machines and other beet implements that will save labor and expense in producing and handling beets, thereby enabling the grower to devote a greater acreage to this crop.

(11) By producing an adequate supply of high-grade sugar-beet seed and by developing strains of sugar beets that will produce a greater tonnage of beets and yield a greater percentage of sugar, making possible a maximum acreage of beets and a maximum production of sugar per acre.



